DETAILED ACTION

Claim Objections

1. Claims 1, 5 - 17 and 19 - 22 are objected to because of the following informalities:

a. Regarding claims 1 and 6 - 15, these claims are replete with parenthetical numbering within the claims (e.g. "*substrate (10)*", "*light-emitting layer (15)*", etc...). The parenthetical number renders the claims unclear and confusing to read. The Examiner requests the parenthetical numbers be removed from the claims.

b. Regarding claims 21 and 22, the claims recite in the 2nd line of each claim "*a minimum horizontal width (lateral width)*". It is unclear and ambiguous what is meant by having the parenthetical limitation *"(lateral width)"*. For purposes of examination, the parenthetical limitation (lateral width) is not given patentable weight, since the term "*horizontal width*" may be interpreted as the lateral width.

c. Claims 5 – 17 and 19 – 22 depend from objected claim 1.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

2. The Examiner acknowledges the amendment(s) to claims 14 and 15 filed on December 7, 2011. The rejection of claim(s) 14 and 15 under USC 112, second paragraph, cited in the previous office action filed on September 7, 2011 is (are) hereby withdrawn.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 1, 5, 9 – 11, 16, 17 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim et al. (US 6,995,389 B2) in view of Narayan et al. (US 2003/0160246 A1), Yamada (US 6,608,330 B1, prior art of record), Sasaoka (US 2003/0042496 A1, prior art of record) and Stintz et al. (US 2002/0114367 A1, prior art of record).

a. Regarding claim 1, **Kim discloses a gallium nitride compound semiconductor light-emitting device** (e.g. figure 1) **comprising**

a crystalline substrate (substrate 10, col. 2, line 55);

a light-emitting layer comprised of a multiple quantum well structure (multiple quantum well structure 18, col. 3, lines 3 – 4) **that is formed of at least one gallium nitride compound semiconductor barrier layer doped with an impurity element** (barrier layers 13, disclosed in col. 3, lines 10 – 12, lines 16 – 18 and lines 36 - 37 to be doped with an impurity element) **and at least one gallium nitride compound semiconductor well layer undoped with any impurity element** (well layers 14, disclosed in col. 23, lines 40 – 47 and col. 3, lines 10 – 18 to be formed of only GaN, and therefore may be considered to be undoped gallium nitride semiconductor well layers), **said light-emitting layer being provided on a second side of the crystalline substrate** (e.g. as seen in figure 1);

a contact layer formed for providing an Ohmic electrode for supplying device operation current to the light-emitting layer (contact layer 15, col. 2, lines 61 - 63); **and**

an Ohmic electrode (metal electrode 16, col. 2, line 64) **that is provided on the contact layer** (e.g. as seen in figure 1) **and has an aperture through which a portion of the contact layer is exposed** (e.g. as seen in figure 1, the sides of electrode 16 are open, exposing the contact layer 15),

wherein all of the individual gallium nitride compound semiconductor well layers of the multiple quantum well structure each has the same composition (e.g. as seen in figure 1, there are multiple gallium nitride compound semiconductor well layers 14, which are disclosed to have the

same composition in col. 3, lines 10 – 18) **and contains a thick portion having a large thickness and a thin portion having a thickness 1.5 nm or less** (col. 3, lines 31 – 33 disclose the thickness of the quantum well layers 14 may be less than 1.5 nm. Regarding the phrase "*a thick portion…and a thin portion*", each quantum well layer 14 may be regarded to have both a thick portion and a thin portion, each of the same thickness, since neither the relative thickness nor the actual thickness of the thick portion has been claimed)**;**

wherein the at least one barrier layer is doped with an element (e.g. col. 3, lines 37 – 40 disclose doping the barrier layer 13 with an element) **for the purpose of decreasing forward voltage of the device** (this is regarded as a statement of intended use, and it has been held by the courts that a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus satisfying the claimed structural limitations. Ex parte Masham 2 USPQ2d 1647 (1987). See MPEP 2114).

Kim is silent with respect to explicitly disclosing the contact layer is formed of a Group III-V compound semiconductor, the Ohmic electrode exhibits light permeability with respect to light emitted from the light emitting layer, the barrier layer is doped with a Group IV element at an average atom density of 1 x 10^{17} cm^{-3} to 5 x 10^{18} cm^{-3}, and the at least one gallium nitride compound semiconductor well layer is a discontinuous layer including a portion having a thickness of 0 nm.

Narayan discloses a gallium nitride compound semiconductor light-emitting device (e.g. figure 2) **comprising**

a contact layer formed of a Group III-V compound semiconductor for providing an electrode for supplying device operation current to the light-emitting layer (contact layer 10, formed from GaN as stated in ¶ [0028]); **and**

at least one gallium nitride compound semiconductor well layer undoped with any impurity element (e.g. gallium nitride compound semiconductor well layer 12, ¶ [0025] and [0028])**, wherein at least one gallium nitride compound semiconductor well layer is a discontinuous layer** (A common definition of “discontinuous" is "marked by breaks or interruptions". Figure 1 and ¶ [0026], [0031] and [0033] disclose that the well layer 12 may be considered as having “breaks" or “interruptions” in the thicknesses of the layer, and therefore the well layer 12 may be considered as "discontinuous").

It would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the device of Kim such that the contact layer is formed of a Group III-V compound semiconductor, since Kim discloses an LED device with an electrode on a contact layer, and Narayan discloses the contact layer to be formed of a Group III-V compound semiconductor. One would have been motivated to form the contact layer of a Group III-V compound in order to create an electrical connection to the quantum well of the device, as well as minimizing lattice mismatch between the layers..

It would have also been obvious for one of ordinary skill in the art at the time the invention was made to modify the device of Kim such that the gallium nitride compound semiconductor well layer is a discontinuous layer since Narayan discloses it is advantageous to form the well layer in an LED device as a discontinuous layer. One would have been motivated to form the well layer as a discontinuous layer in order to increase the luminous efficiency and color rendering properties of the device (as discussed in Narayan, ¶ [0034]).

Yamada discloses a gallium nitride compound semiconductor light-emitting device (e.g. figure 1) **comprising an Ohmic electrode** (electrode 112) **that is provided on the contact layer** (e.g. as seen in figure 1, contact layer 111) **and has an aperture through which a portion of the contact layer is exposed** (e.g. as seen in figure 1, the sides of electrode 112 are open, exposing the contact layer 111), **wherein the Ohmic electrode exhibits light permeability with respect to light emitted from the light-emitting layer** (col. 10, line 42 discloses the electrode 112 to be transparent).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the device of Kim such that the Ohmic electrode exhibits light permeability with respect to light emitted from the light emitting layer, since Kim discloses an LED device with an Ohmic electrode on a contact layer, and Yamada discloses the Ohmic electrode on the contact layer exhibits a light permeability. One would have been motivated to form the Ohmic electrode such that it exhibits a light permeability with respect to the light emitting

from the light emitting layer in order to allow light emitted in the direction of the Ohmic electrode to pass thought the electrode, thereby increasing light intensity emitted from the device.

Stintz discloses that a gallium compound semiconductor well layer of a light emitting device may have a portion having a thickness of 0 nm (as seen in figure 11C, layer 408 has portions that are zero thickness (0 nm), such that layers 406 exists between the layer 408).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the device of Kim in view of Narayan such that the at least one gallium nitride compound semiconductor well layer includes a portion having a thickness of 0 nm, since Narayan discloses the well layer to have portions with varying thickness and the benefits of having a varying thickness, and Stintz discloses that quantum well layers may be discontinuous such that there are regions of the layer with zero thickness. Furthermore, it has been held that in the case where the claimed ranges overlap or lie inside the ranges disclosed by the prior art, then a prima facie case of obviousness exists (See MPEP 2144.05). One would have been motivated to have a portions of the well layer with zero thickness in order to create quantum confinement regions that would alter the characteristics of the light emitting layer, allowing one to control and optimize the light emitted by the device (as seen in figure 12 of Stintz).

Sasaoka discloses a gallium nitride compound semiconductor light-emitting device with barrier layer being doped with a Group IV element at an average atom density of $1x10^{17}$ cm^{-3} to $5x10^{18}cm^{-3}$ which exhibits a low resistance (¶ [0109] discloses the barrier layer to be Si doped with a concentration of $1x10^{18}$ cm^{-3}).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the device of Kim such that the barrier layers are doped with a Group IV compound with a density of $1x10^{17}$ cm^{-3} to $5x10^{18}cm^{-3}$ since Kim discloses doping the barrier layers with n type or p type dopants, and it was known that gallium nitride compound light emitting devices can contain barrier layers with such dopants and concentrations, as disclosed by Sasaoka. One would have been motivated to make the barrier layer with a dopant of Group IV materials since these would create an n-type semiconductor barrier layer, allowing one to control the conductivity of the barrier layer, resulting in a more efficient light emission properties of the quantum well.

b. Regarding claim 5, **Kim in view of Narayan, Yamada, Sasaoka and Stintz further disclose a gallium nitride compound semiconductor light-emitting device, as cited above, wherein the predetermined impurity element added only to the barrier layer is silicon** (Sasaoka: ¶ [0109] discloses the impurity element added to the barrier layer is silicon).

c. Regarding claim 9, **Kim in view of Narayan, Yamada, Sasaoka and Stintz disclose a gallium nitride compound semiconductor light-emitting device according to claim 1, as cited above, however Kim is silent with respect to the contact layer having a thickness of 1 μm to 3 μm, however Yamada discloses that the contact layer thickness is 0.25 μm** (col. 10, line 32).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to enlarge the layer thickness of Kim in view of Narayan, Yamada, Sasaoka and Stintz, since Yamada discloses a contact layer in a similar device may be near the claimed thickness, and it has been held by the courts that, where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device, and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device. *In Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984). One would be motivated to make such a modification of the layer thickness in order to make the device structurally more rigid.

d. Regarding claim 10, **Kim in view of Narayan, Yamada, Sasaoka and Stintz disclose a gallium nitride compound semiconductor light-emitting device according to claim 1, as cited above, wherein the Ohmic electrode**

exhibits a transmittance at the wavelength of emitted light of 30% or higher (the structure of Kim in view of Narayan, Yamada, Sasaoka and Stintz are obvious over the structure of the claimed invention, therefore Kim in view of Yamada, Sasaoka and Stintz are obvious over the properties of the light transmittance of the Ohmic electrode, since it has been held that when the prior art discloses the structure of the claimed invention, a prima facie case of anticipation or obviousness of the inherent properties has been established. See MPEP 2112.01.)

e. Regarding claim 11, **Kim in view of Narayan, Yamada, Sasaoka and Stintz further disclose a gallium nitride compound semiconductor light-emitting device according to claim 1, as cited above. Although Kim is silent with respect to disclosing the Ohmic electrode has a thickness of 1 nm to 100 nm, Yamada discloses an Ohmic electrode has a thickness of 20 nm** (col. 10, lines 42 – 43).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the device of Kim in view of Narayan, Yamada, Sasaoka and Stintz such that the electrode has a thickness of 1nm to 100 nm since Kim is silent with respect to the electrode thickness, and Yamada teaches a similar light emitting device with an electrode thickness of between 1 nm and 100 nm. One would have been motivated to for the electrode between 1 nm and

100 nm to optimize electrode structural stability, device size, and electrical capabilities.

f. Regarding claims 16 and 17, **Kim in view of Narayan, Yamada, Sasaoka and Stintz further disclose a lamp and an LED employing the gallium nitride compound semiconductor light- emitting device according to claim 1** (Kim: e.g. figures 1 and 12).

g. Regarding claim 19, **Kim in view of Yamada, Sasaoka and Stintz further disclose a gallium nitride compound semiconductor light-emitting device according to claim 1, as cited above, wherein the at least one barrier layer is an Si-doped n-type GaN barrier layer** (Sasaoka: ¶ [0109] discloses the Group IV doped GaN barrier layer to be Si doped n-type GaN).

6. Claims 6 – 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of Narayan, Yamada, Sasaoka and Stintz, as cited above with respect to claim 1, and in further view of Hanaoka et al. (US 5,804,839, prior art of record).

a. Regarding claim 6, **Kim in view of Narayan, Yamada, Sasaoka and Stintz disclose a gallium nitride compound semiconductor light-emitting device according to claim 1, as cited above. However, Kim, Narayan, Yamada, Sasaoka and Stintz are silent with respect to the contact layer**

being doped with an n- type impurity element and has a carrier concentration of 5 x 10^{18} cm^{-3} to 2 x 10^{19} cm^{-3}.

Hanaoka discloses a similar light emitting device (e.g. figure 1), **wherein a GaN contact layer** (contact layer 17, col. 3, line 10) **may be formed with n-type impurity concentrations of 1 x 10^{19} cm^{-3}** (col. 9, lines 20 - 23).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the contact layer of Kim in view of Narayan, Yamada, Sasaoka and Stintz to include n-type impurities with a concentration of 1 x 10^{19} cm^{-3} since Hanaoka discloses that a contact layer within a light emitting device may have the claimed structure. One would have been motivated to make such a modification since it would allow the layer to exhibit light transmission properties, allowing the light to transmit readily through the layer, and desirable electrical properties for tuning the light emitting device (Hanaoka: col. 8, line 52 - col. 9, line 23).

b. Regarding claims 7 and 8, **Kim in view of Narayan, Yamada, Sasaoka and Stintz disclose a gallium nitride compound semiconductor light-emitting device according to claim 1, as cited above, wherein the contact layer is doped with a p - type impurity element** (Narayan: contact layer 10, ¶ [0028]). **Kim, Narayan, Yamada, Sasaoka, and Stintz are silent with respect to the layer having a carrier concentration of 1 x 10^{17} cm^{-3} to 1 x 10^{18} cm^{-3}.**

Hanaoka teaches that p-type contact layers may be doped with a carrier concentration of 1 x 10^{18} cm^{-3} (col. 3, lines 48 – 49).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the contact layer of Kim in view of Narayan, Yamada, Sasaoka and Stintz to have a p-type impurity concentration of 1 x 10^{18} cm^{-3} since Hanaoka discloses that this is known contact layer structure used in light emitting devices. One would have been motivated to make such a modification since it would allow the layer to exhibit light transmission properties, allowing the light to transmit readily through the layer, and desirable electrical properties for tuning the light emitting device (Hanaoka: col. 8, line 52 - col. 9, line 23).

7. Claims 12, 13, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of Narayan, Yamada, Sasaoka and Stintz, as applied to claim 1 above, and in further view of Morita et al. (US 6,121,636, prior art of record).

Kim in view of Narayan, Yamada, Sasaoka and Stintz disclose a gallium nitride compound semiconductor light-emitting device according to claim 1, as cited above, however Kim, Narayan, Yamada, Sasaoka, and Stintz are silent with respect to a multilayered metallic reflecting mirror made of the same material identical to the Ohmic electrode for reflecting light emitted from the light-emitting layer to the outside, which is provided on a first side of the crystalline substrate.

Morita discloses a mirror on the outside first side of the crystalline substrate (e.g. figure 1, reflecting layer 11) **wherein the metallic reflecting mirror contains a metallic material identical to that contained in the Ohmic electrode** (e.g. col. 4, lines 1 – 9, discloses that the layer may be made of gold, which is the same material as the electrode 9). **Morita further discloses that the layers may be multilayered** (col. 2, lines 21 - 25).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the light emitting device of Kim in view of Narayan, Yamada, Sasaoka and Stintz to include the reflecting mirror, as taught by Morita, since Morita discloses that multilayer reflecting mirrors, made of the same material as the electrode, can be added to light emitting devices. One would be motivated to add a reflecting mirror on the second side of the substrate in order to prevent light escaping from the bottom of the device, thereby protecting underlying structures, as taught in Morita in col. 8, lines 33 - 44. One would be motivated to make the reflecting mirror multilayered to enhance it reflecting ability. One would further be motivated to make the mirror of the same material as that of the Ohmic electrode since it would require fewer materials for the production process.

8. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of Narayan, Yamada, Sasaoka, Stintz, and Morita, as applied to claim 12 above, and in further view of Kaneyama et al. (US 6,452,214 B2, prior art of record).

Kim in view of Narayan, Yamada, Sasaoka, Stintz and Morita disclose a gallium nitride compound semiconductor light-emitting device according to claim 12, as cited above, however Kim, Yamada, Sasaoka, Stintz and Morita are silent with respect to a metallic reflecting mirror containing a single-metal film or an alloy film formed from at least one member selected from the group consisting of silver, platinum, rhodium and aluminum.

Kaneyama teaches a metallic reflecting mirror formed from aluminum (col. 4, lines 32 - 35).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the light emitting device of Kim in view of Narayan, Yamada, Sasaoka, Stintz and Morita such that the reflecting mirror is made from aluminum, since Morita discloses the reflecting metal may be formed from a metal (Morita: e.g. gold, col. 4, lines 1 – 9) and Kaneyama discloses that reflecting mirrors made of aluminum can be added to light emitting devices. One would be motivated to use aluminum for the reflecting mirror since aluminum is a readily available and inexpensive material that is can be easily deposited on substrates via known deposition methods (i.e. sputtering, evaporation, etc...)

9. Claims 20 – 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of Narayan, Yamada, Sasaoka and Stintz as applied to claim 1 above, and further in view of Lester (US 6,291,839 B1, prior art of record).

a. Regarding claim 20, **Kim in view of Narayan, Yamada, Sasaoka and Stintz disclose a gallium nitride compound semiconductor light-emitting device according to claim 1, but are silent with respect to apertures are formed such that a total surface area of the apertures accounts for 30% to 80% of a surface of the contact layer.**

Lester discloses a gallium nitride compound semiconductor light-emitting device (e.g. figure 1), **wherein apertures are formed in an Ohmic electrode** (openings in p-type contact 20, as disclosed in col. 3, lines 1 - 3) **such that a total surface area of the apertures accounts for 30% to 80% of a surface of the contact layer** (as disclosed in col. 4, lines 34 - 35).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the gallium nitride semiconductor light-emitting device of Kim in view of Narayan, Yamada, Sasaoka and Stintz such that the Ohmic electrode comprises a apertures with a total surface area of 30 - 80% of the surface of contact layer since Lester discloses a similar device with similar structure wherein apertures with such configurations may be formed. One would have been motivated to have apertures of such dimensions in order to optimize light transmittance from the device while providing an even Ohmic contact, as discussed by Lester (col. 3, lines 34 - 40).

b. Regarding claim 21, **Kim in view of Narayan, Yamada, Sasaoka and Stintz disclose gallium nitride compound semiconductor light-emitting**

device according to claim 1, wherein a metallic film consists the Ohmic electrode (Kim: col. 2, line 64 disclose the Ohmic electrode to be a metal, and Yamada: col. 10, lines 42 – 43 disclose electrode 112 to be gold and nickel). **Kim in view of Narayan, Yamada, Sasaoka and Stintz are silent with respect to a minimum horizontal width (lateral width)** (see claim objection above) **of the metallic film consisting the Ohmic electrode is 10 μm or less, and a horizontal width of the aperture is 0.5 μm to 50 μm.**

Lester discloses a gallium nitride compound semiconductor light-emitting device (e.g. figure 1), **wherein a horizontal width of the aperture is 0.5 μm to 50 μm** (e.g. figure 1 and col. 3, lines 1 -3 disclose that the Ohmic layer may comprise openings (apertures). Col. 3, lines 21 – 22 disclose the dimensions of the openings). **Lester also discloses that a total surface area of the apertures accounts for 30% to 80% of a surface of the contact layer** (as disclosed in col. 4, lines 34 - 35).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the device of Kim in view of Narayan, Yamada, Sasaoka and Stintz such that the Ohmic electrode comprises apertures with a horizontal width of 0.5 μm to 50 μm since Lester discloses a similar device with an Ohmic layer comprising apertures of such dimensions. One would have been motivated to have the apertures of a width between 0.5 μm to 50 μm in order to maximize current flow in the Ohmic contact while optimizing the light

transmittance through the apertures of the Ohmic layer, as discussed by Lester (col. 3, lines 5 – 22).

The combination of Kim in view of Narayan, Yamada, Sasaoka and Stintz with the teachings of Lester disclose a device that is obvious over the limitation of a minimum horizontal width (lateral width) of a metallic film consisting the Ohmic electrode is 10 μm or less. Yamada discloses the device to have an area of 350 μm square (col. 10, line 53), **of which the Ohmic layer of Kim in view of Narayan, Yamada, Sasaoka and Lester comprises a large portion** (e.g. as seen in figures 1 of Kim, Yamada and Lester). **Since Lester discloses the total surface area of the apertures to account for 20 - 80% of the surface area, and the dimensions of the apertures to be 0.5 – 20 μm, one may do the calculations to find the average horizontal distance between the apertures to be about 0.4 μm.**

Although this calculation is done using an estimated contact layer size similar to the size of the area of device as disclosed by Kim and Yamada, and average homogeneous distribution of apertures within the Ohmic contact layer, a prima facie case of obviousness is established that a minimum horizontal width of the metallic film comprising the Ohmic electrode is 10 μm or less, and it has been held that when the prior art discloses the general conditions of the claimed invention, discovering the optimum or workable ranges involves only ordinary skill in the art. See MPEP 2144.05. One would have been motivated to have a minimum horizontal distance of the metallic film comprising the Ohmic electrode

of 10 μm or less in order to optimize the current flow in the Ohmic contact while optimizing the light transmittance through the apertures of the Ohmic layer, as discussed by Lester (col. 3, lines 5 – 22).

c. Regarding claim 22, **Kim in view of Narayan, Yamada, Sasaoka and Stintz and in further view of Lester disclose a gallium nitride compound semiconductor light-emitting device according to claim 20, wherein a horizontal width of the aperture is 0.5 μm to 50 μm** (Lester: col. 3, line 22).

Regarding the claim limitation "wherein a minimum horizontal width (lateral width) of a metallic film consisting the Ohmic electrode is 10 μm or less", **the combination of Kim in view of Narayan, Yamada, Sasaoka and Stintz with the teachings of Lester disclose a device that is obvious over the limitation of a minimum horizontal width (lateral width) of a metallic film comprising the Ohmic electrode is 10 μm or less. Yamada discloses the device to have an area of 350 μm square** (col. 10, line 53), **of which the Ohmic layer of Kim in view of Yamada, Sasaoka, Stintz and Lester comprises a large portion** (e.g. as seen in figures 1 of Kim, Yamada and Lester). **Since Lester discloses the total surface area of the apertures to account for 20 - 80% of the surface area, and the dimensions of the apertures to be 0.5 – 20 μm, one may do the calculations to find the average horizontal distance between the apertures to be about 0.4 μm.**

Although this calculation is done using an estimated contact layer size similar to the size of the area of device as disclosed by Kim and Yamada, and average homogeneous distribution of apertures within the Ohmic contact layer, a prima facie case of obviousness is established that a minimum horizontal width of the metallic film comprising the Ohmic electrode is 10 μm or less, and it has been held that when the prior art discloses the general conditions of the claimed invention, discovering the optimum or workable ranges involves only ordinary skill in the art. See MPEP 2144.05. One would have been motivated to have a minimum horizontal distance of the metallic film comprising the Ohmic electrode of 10 μm or less in order to optimize the current flow in the Ohmic contact while optimizing the light transmittance through the apertures of the Ohmic layer, as discussed by Lester (col. 3, lines 5 – 22).

Double Patenting

10. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140

F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

11. Claims 1, 5, 16, 17, and 19 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1, 2, 4, 5, 9, 10, 18 and 20 of U.S. Patent No. 7,482,635 in view of Kim et al. and Yamada et al. Regarding claims 1, 5, 16, 17 and 19 of the current application, claims 1, 2, 4, 5, 9, 10, 18 and 20 of U.S. Patent No. 7,482,635 claim most of the multiple quantum well structure, including the doped gallium nitride barrier layer and the gallium nitride semiconductor well layer, wherein the well layer is discontinuous and includes a portion of 0 nm thickness. U.S. Patent No. 7,482,635 does not claim the rest of the structural

formations as claimed in claim 1 of the current application, such as the substrate, a contact layer, and the Ohmic electrode on the contact layer. However, the devices of Kim and Yamada disclose the remaining claimed structure for forming the claimed invention of claims 1, 5, 16, 17, and 19. Therefore, it would have been obvious to one of ordinary skill in the art to incorporate the structure of Kim and Yamada into the claims of U.S. Patent No. 7,482,635, since the claims of U.S. Patent No. 7,482,635 are directed to a gallium nitride compound quantum well structure, and it was known in the art to use gallium nitride compound quantum well structures for light emitting devices, as disclosed by Kim and Yamada.

Response to Arguments

12. Applicant's arguments, see pages 9 – 10 of Remarks, filed December 7, 2011, with respect to the rejection(s) of claim(s) 1 under the Yamada reference in combination with the Kim reference have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of the prior art of Narayan et al., as cited above.

13. Applicant's arguments with respect to the Kim reference (see pages 8 and 9 of Remarks) filed December 7, 2011 have been fully considered but they are not persuasive.

a. With respect to claim 1, the Applicant argues that Kim does not disclose the claimed limitation that all of the individual gallium nitride semiconductor well layers has the same composition since Kim discloses the reservoir layers 12 to

contain less In concentration than the well layers 14 (see page 8 of Remarks). The Examiner respectfully submits that the reservoir layers 14 are NOT interpreted to be part of the semiconductor well layers, and therefore their composition is not relevant to the structure, as claimed. The claimed structure does not preclude the addition of other layers, but only that the semiconductor well layers have the same composition. As explicitly disclosed by Kim, the semiconductor well layers are quantum well layers 14, and the reservoir layers 12 are not semiconductor well layers. Therefore, the Examiner maintains that Kim discloses all of the semiconductor well layers, disclosed to be quantum well layers 14, do have the same composition.

b. With respect to claim 1, the applicant argues that Kim does not disclose the well layers have a thickness less than 1.5 nm (see pages 8 – 9 of Remarks). The Examiner respectfully disagrees. Clearly, Kim teaches in col. 3, lines 31 - 33 that the quantum well layers 14 can have a thickness between 5 angstroms and 100 angstroms. Since Kim discloses the quantum well layers can have a thickness as small as 5 angstroms (i.e. 0.5 nm), Kim clearly anticipates or renders obvious the limitation that the semiconductor well layers have a thickness of 1.5 nm or less.

c. With respect claim 1, the applicant argues that Kim does not disclose the barrier layer is doped at a density of 1×10^{17} cm^{-3} to 5×10^{18} cm^{-3}. The Examiner

recognizes that Kim does not disclose the density at which the barrier layer is doped. However, the prior art of Sasaoka discloses a barrier layer being doped with a Group IV element at an average atom density of $1 \times 10^{17}\,cm^{-3}$ to $5 \times 10^{18} cm^{-3}$. The Examiner submits that Kim in view of Sasaoka renders obvious the claimed limitation, as cited above with respect to claim 1.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ROBERT HUBER whose telephone number is (571)270-3899. The examiner can normally be reached on Monday - Friday (11am - 7pm EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thao Le can be reached on (571) 272-1708. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/Robert Huber/
Primary Examiner, Art Unit 2892
February 10, 2012